



Fact Sheet

California Environmental Protection Agency

 **Air Resources Board**

Hybrid Electric Vehicles

Hybrid electric vehicles (HEVs) commercially available today combine an internal combustion engine with a battery and electric motor. This combination offers the extended range and rapid refueling of a conventional vehicle, while reducing energy requirements and emissions of today's vehicles. The practical benefits of HEVs include improved fuel economy and lower emissions compared to conventional vehicles. The inherent flexibility of HEVs allows them to be used in a wide range of applications, from personal transportation to commercial hauling.

Environmental Benefits

More efficient cars can make a big difference to society in terms of environmental benefits, and the serious deterioration of urban air has motivated regulators to require cleaner cars. Production HEVs will reduce smog-forming pollutants over the current national average. Hybrids will never be true zero-emission vehicles, however, because of their internal combustion engine. But hybrids certified to the ARB's super ultra low emission standard can significantly reduce ozone precursor emissions and global-warming pollutants by a third to a half, and future models may cut emissions by even more.

Perks and Conveniences

Auto manufacturers have begun to produce HEVs with comparable performance, safety, and cost to conventional vehicles. By combining gasoline with electric power, hybrids have the same or greater range than traditional combustion engines, thus reducing the number of trips to the gasoline station. Improved fuel economy reduces greenhouse gas emissions and provides savings to help offset the incremental capital cost of the vehicle.

Refueling

Today's hybrid electric vehicles refuel at the gas station. These vehicles use both gasoline and electricity that is generated on-board the vehicle. As a result, refueling is the same as conventional vehicles, although generally required less often due to improved fuel economy. Future HEVs may refuel at both the gas station and plug in, and thus offer more electric drive miles, improve efficiency, and reduce operating costs.

Technology

Many configurations are possible for HEVs. Essentially, a hybrid combines an energy storage system, a power unit such as a spark ignition engine, and a vehicle propulsion system. The primary options for energy storage include batteries, ultracapacitors, and flywheels. Although batteries are by far the most common energy storage choice, research is still being done in other energy storage areas. Propulsion can come entirely from an electric motor, such as in a series configuration, or the engine might provide direct mechanical input to the vehicle propulsion system in a parallel configuration system. A hybrid's efficiency and emissions depend on the particular combination of subsystems, how these subsystems are integrated into a complete system, and the control strategy that integrates the subsystems. A hydrogen fuel cell hybrid, for example, would produce



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only water as a by-product and run at greater overall efficiency than a battery-electric vehicle that uses wall-plug electricity.

Facts

- HEVs are substantially more efficient than conventional vehicles.
- Regenerative braking helps minimize energy loss and recover the energy used to slow down or stop a vehicle.
- Engines can be sized to accommodate average load, not peak load, which reduces the engine's weight.
- Fuel efficiency is greatly increased (hybrids consume significantly less fuel than vehicles powered by gasoline alone).
- Emissions are decreased.
- HEVs can reduce dependency on fossil fuels because they can run on alternative fuels.

Safety

Hybrid-electric vehicles meet all federal motor vehicle safety requirements. The batteries in HEVs are sealed and all high-voltage circuits are protected from casual contact. High-voltage circuits are marked, color-coded and posted with warnings to advise of their presence. These vehicles pose no additional risks over a conventional vehicle.

Where can I get more information?

Please contact the ARB toll-free at (800) END-SMOG/(800) 363-7664 (California only) or (800) 272-4572. You may obtain this document in an alternative format by contacting ARB's Americans with Disabilities Act Coordinator at (916) 322-4505 (voice); (916) 324-9531 (TDD, Sacramento only); or (800) 700-8326 (TDD, outside Sacramento).